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Final Report -- Structured and Collaborative Signal Models: Theory and Applications in Image, Video, and Audio Analysis

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6. AUTHORS

Guillermo Sapiro

5d. PROJECT NUMBER

5e. TASK NUMBER

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7. PERFORMING ORGANIZATION NAMES AND ADDRESSES

University of Minnesota - Minneapolis
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14. ABSTRACT

In this report we describe the core results of this project on the topic of novel structured sparse models and its applications to image, video, and audio processing. As reflected in the publications list, we have accomplished all the basic expected results from the original proposal, presenting both new theory and state-of-the-art practical results, including numerous technology transfers.

15. SUBJECT TERMS

Sparse modeling, structure, hierarchical models, images, video, audio

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	15. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Guillermo Sapiro
UU	UU	UU	UU		19b. TELEPHONE NUMBER 919-684-3030

Report Title

Final Report -- Structured and Collaborative Signal Models:
Theory and Applications in Image, Video, and
Audio Analysis

ABSTRACT

In this report we describe the core results of this project on the topic of novel structured sparse models and its applications to image, video, and audio processing. As reflected in the publications list, we have accomplished all the basic expected results from the original proposal, presenting both new theory and state-of-the-art practical results, including numerous technology transfers.

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

Received		Paper
02/22/2012	5.00	I. Ramirez, G. Sapiro. An MDL framework for sparse coding and dictionary learning, IEEE Transactions on Signal Processing, (03 2012): 0. doi: 10.1109/TSP.2012.2187203
02/23/2012	4.00	Ignacio Ramirez, Guillermo Sapiro, Yonina C. Eldar, Pablo Sprechmann. C-HiLasso: A Collaborative Hierarchical Sparse Modeling Framework, IEEE Transactions on Signal Processing, (09 2011): 0. doi: 10.1109/TSP.2011.2157912
02/23/2012	3.00	Guoshen Yu, Guillermo Sapiro. Statistical Compressed Sensing of Gaussian Mixture Models, IEEE Transactions on Signal Processing, (12 2011): 0. doi: 10.1109/TSP.2011.2168521
TOTAL:	**3**	

Number of Papers published in peer-reviewed journals:

(b) Papers published in non-peer-reviewed journals (N/A for none)

Received		Paper
TOTAL:		

Number of Papers published in non peer-reviewed journals:

(c) Presentations

We have delivered a number of presentations at universities, including

February Fourier Talks (FFT) at the Norbert Wiener Center, University of Maryland, February 2012.

Foundations of Computational Mathematics, Budapest, July 2011.

Plenary Speaker, 1st Technion Computer Engineering (TCE) Conference, June 2011.

Number of Presentations: 3.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received	Paper

TOTAL:

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received	Paper	
03/21/2012	7.00	P. Sprechmann, P. Cancela, G. Sapiro. GAUSSIAN MIXTURE MODELS FOR SCORE-INFORMED INSTRUMENT SEPARATION, IEEE ICASSP 2012. 2012/03/28 01:00:00, . : ,
07/12/2012	9.00	P. Sprechmann, A. Bronstein, G. Sapiro. Learning efficient structured sparse models, ICML 2012. 2012/06/30 00:00:00, . : ,
07/12/2012	10.00	Alexey Castrodad, Timothy Khuon, Robert Rand, Guillermo Sapiro. SPARSE MODELING FOR HYPERSPECTRAL IMAGERY WITH LIDAR DATA FUSION FORSUBPIXEL MAPPING, IEEE International Geoscience and Remote Sensing Symposium. 2012/07/15 00:00:00, . : ,
07/12/2012	11.00	Ehsan Elhamifar, Guillermo Sapiro, Rene Vidal. See all by looking at a few: Sparse modeling for finding representative objects, IEEE Computer Vision Patter Recognition. 2012/06/25 00:00:00, . : ,
TOTAL:	**4**	

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):

(d) Manuscripts

Received	Paper	
01/22/2013	12.00	E. Esser, M. Moller, S. Osher, G. Sapiro, and J. Xin. A convex modelfor non-negative matrix factorization and dimensionality reduction onphysical space, IEEE Transaction on Image Processing (03 2012)
01/22/2013	17.00	Alexey Castrodad, Zhengming Xing, John B. Greer, Edward Bosch, Lawrence Carin, , and Guillermo Sapiro,. Learning Discriminative Sparse Representationsfor Modeling, Source Separation, and Mappingof Hyperspectral Imagery, IEEE Transactions on Geoscience and Remote Sensing (11 2011)
01/22/2013	16.00	G. Yu, G. Sapiro, S. Mallat. Solving inverse problems with piecewiselinear estimators: From Gaussian mixture models to structuredsparsity, IEEE TRANSACTIONS ON Image Processing (11 2011)
01/22/2013	15.00	I. Ramirez and G. Sapiro. An MDL framework for sparse coding anddictionary learning, IEEE Trans Signal Processing (07 2012)
01/22/2013	14.00	A. Castrodad, G. Sapiro. Sparse modeling of human actions frommotion imagery, INTERNATIONAL JOURNAL Computer vision (09 2012)
01/22/2013	13.00	I. Ramirez, G. Sapiro. Universal Regularizers For Robust Sparse Codingand Modeling, IEEE Trans Image Processing (03 2012)
01/23/2013	18.00	Guillermo Sapiro. Comparing shapes, understanding evolution, Proceedings National Academy of Sciences (07 2012)
01/23/2013	19.00	P. Sprechmann, I. Ramirez, Y. Eldar, G. Sapiro. C-HiLasso: A Collaborative HierarchicalSparse Modeling Framework , IEEE TRANSACTIONS ON Signal Processing (09 2011)
02/21/2012	1.00	M. Mahmoudi and G. Sapiro. Sparse Representations for Range Data Restoration, IEEE Trans. on Image Processing (11 2011)
02/22/2012	2.00	B. Wirth, L. Bar, M. Rumpf, G. Sapiro. A Continuum Mechanical Approach to Geodesics in Shape Space, INTERNATIONAL JOURNAL Computer vision (01 2010)
03/21/2012	8.00	Ernie Esser, Michael M¨oller, Stanley Osher, Guillermo Sapiro, Jack Xin. A convex model for non-negative matrixfactorization and dimensionality reduction onphysical space, IEEE Transactions image processing (03 2012)
TOTAL:	**11**	

Number of Manuscripts:

Books

Received	Paper

TOTAL:

Patents Submitted

We still have one patent pending (with Adobe):
X. Bai, J. Wang, and G. Sapiro, Methods and apparatus for dynamic color modeling.

Patents Awarded

Awards

Success story from the National Geospatial-Intelligence Agency Basic Research Program (NURI)

2011: Test-of-Time Award, International Conference Computer Vision, Geodesic Active Contours ICCV '95 paper.

2012: Best Poster Award, P. Sprechmann, A. Bronstein, and G. Sapiro, Real-time online singing voice separation from monaural recordings using robust low-rank modeling, International Society for Music Information Retrieval Conference, Porto, October 2012.

Graduate Students

NAME	PERCENT_SUPPORTED	Discipline
Liron Yatziv	0.00	
Pablo Sprechmann	1.00	
Alexey Castrodad	0.00	
Ignacio Ramirez	1.00	
Federico LEcumberry	0.00	
Marcelo Fiori	0.00	
FTE Equivalent:	**2.00**	
Total Number:	**6**	

Names of Post Doctorates

NAME	PERCENT_SUPPORTED
Oleg Kuybeda	1.00
Mariano Tepper	1.00
Christophe Lenglet	0.00
FTE Equivalent:	**2.00**
Total Number:	**3**

Names of Faculty Supported

NAME	PERCENT_SUPPORTED	National Academy Member
Guillermo Sapiro	0.10	No
FTE Equivalent:	**0.10**	
Total Number:	**1**	

Names of Under Graduate students supported

NAME	PERCENT_SUPPORTED	Discipline
F. Leger	1.00	Mathematics
FTE Equivalent:	**1.00**	
Total Number:	**1**	

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period:	1.00
The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:	1.00
The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:	1.00
Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):	1.00
Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:	0.00
The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense	0.00
The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields:	1.00

Names of Personnel receiving masters degrees

NAME	
Marcelo Fiori	
Total Number:	**1**

Names of personnel receiving PHDs

NAME	
Ignacio Ramirez	
Federico Lecumberry	
Pablo Sprechmann	
Liron Yatziv	
Alexey Castrodad	
Total Number:	**5**

Names of other research staff

NAME	PERCENT_SUPPORTED
FTE Equivalent:	
Total Number:	

Sub Contractors (DD882)

Inventions (DD882)

Scientific Progress

The complete description of the accomplishments can be found in the uploaded papers, and they include:

* Complete connection between sparse modeling and information theory via MDL and universal modeling.

* New hierarchical collaborative and structured sparse model with applications in source separation and recovery guarantee.

* Full theory of statistical compressed sensing for structured GMM and its applications to state-of-the-art inverse problems in image and audio processing.

* State-of-the-art applications of structured sparse modeling for activity recognition and hypespectral imaging classification.

Technology Transfer